

B5

- 1 38. (Amended) A method as claimed in Claim 28 in which the cross-sectional area of the
- 2 communicating bore through the first layer adjacent the component is at least half the
- 3 area of the component in plan view.

REMARKS

Claims 1 to 27, 29, 34 and 38 are rejected under 35 U.S.C. 112. Furthermore, claims 28, 30 to 33, 35 to 37 and 39 are objected to.

The rejection of claim 1 is traversed.

The Examiner states that the phrase "... prior to bonding the one of the second and third layers to the second etch stop layer, patterning the second etch stop layer to define the component in the second layer for facilitating etching of the second layer through the third layer; bonding the one of the second and third layers to the second etch stop layer ..." is unclear. Applicants contend that this phrase is eminently clear.

The method of claim 1 is for forming a semiconductor device that is to comprise
first, second and third layers. The second layer is to have a component formed therein. A first etch stop layer is located between the first and second layers, and a second etch stop layer is located between the second and third layers. The second etch stop layer is to be bonded to one of the second and third layers. In other words, the second etch stop layer may be bonded to either the second layer or to the third layer. For example, if the second etch stop layer were grown or deposited on the second layer, then the second etch stop layer would be bonded to the third layer. On the other hand, if the second etch stop layer were grown or deposited on the third layer, then the second etch stop layer would be bonded to the second layer. Accordingly, since the essence of the invention is to

provide a buried patterned etch stop layer which facilitates forming the component in the second layer after the first, second and third layers have been laminated together, claim 1 merely claims the process for achieving this by claiming the fact that:

- (a) prior to bonding the one of the second and third layers to the second etch stop layer, patterning the second etch stop layer to define the component in the second layer for facilitating etching of the second layer through the third layer, *and then*
- (b) bonding the one of the second and third layers to the second etch stop layer.

However, since the passage preceding the phrase to which the Examiner is objecting states that “at least the second etch stop layer being bonded to one of the second and third layers,” Applicant has revised the alleged offending passage as follows:

“prior to bonding the second etch stop layer to the one of the second and third layers, patterning the second etch stop layer to define the component in the second layer for facilitating etching of the second layer through the third layer, bonding the second etch stop layer to the one of the second and third layers, and ...”

In view of this amendment, it is respectfully submitted that claim 1 now clearly and unambiguously claims the invention.

Turning now to the amendment to claim 1 proposed by the Examiner at page 3 of the Office Action, it is respectfully submitted that the Examiner’s proposed amendment is unnecessary, and indeed, the Examiner’s proposed amendment adds nothing to the clarity of the claim. As the Examiner states in the Office Action, the specification does disclose the second etch stop layer 9 as being grown on the upper surface 26 of the second layer 5, and after patterning of the second etch stop layer 9 the third layer 6 is bonded to the second etch stop layer 9. However, the Examiner’s attention is respectfully drawn to the

specification at page 2, line 29 to page 3, line 9 where the method for forming a semiconductor device is clearly described. At page 3 from line 2 to line 9 the method is described as comprising the steps of:

1. prior to bonding the one of the second and third layers to the second etch stop layer, patterning the second etch stop layer to define the component in the second layer for facilitating etching of the second layer through the third layer,
2. bonding the one of the second and third layers to the second etch stop layer, and
3. etching the second layer through the third layer and the second etch stop layer for forming the component in the second layer.

Further, at page 7, line 4 to line 14 of the specification, the semiconductor device is described as comprising first, second and third layers, and a component formed in the second layer. The semiconductor device is described as having first and second etch stop layers located between the first and second layers and the second and third layers, respectively. Further, the semiconductor device at lines 9 and 10 is described as comprising at least the second etch stop layer being bonded to one of the second and third layers. The description of the semiconductor device at lines 10 to 13 states that prior to bonding the second etch stop layer to the one of the second and third layers, the second etch stop layer is to be patterned to define the component in the second layer for facilitating etching of the second layer through the third layer and the second etch stop layer. The second layer of the semiconductor device is then etched subsequent to the second etch stop layer having been bonded to the one of the first and second etch stop

layers. This aspect of the disclosure has already been drawn to the attention of the Examiner in the Applicants' response that was filed on July 18, 2002.

Accordingly, in view of the amendment to claim 1, and the disclosure in the specification just discussed, it is respectfully submitted that claim 1 clearly and unambiguously claims the invention. Applicants therefore contend that claim 1 should be allowable, and allowance is respectfully requested.

Turning now to the objection to claim 28, it is respectfully submitted that the amendment proposed by the Examiner renders the claim meaningless. The last step in the method of claim 28 requires "etching a part of a portion of the first etch stop layer adjacent the portion of the second layer where the component is to be formed for thinning the first etch stop layer adjacent the portion of the second layer where the component is to be formed" the portion of the first etch stop layer is to be etched "to an effective stress relieving depth for relieving stress in the portion of the second layer where the component is to be formed".

The Examiner's attention is respectfully drawn to the specification at page 13, line 13 to page 14, line 11, and in particular, page 13, line 23 to page 13, line 27, where the reason for the last etching step of claim 28 is explained. Applicants describe the problem that the etching step of claim 28 is to overcome as follows:

"The provision of oxide layers, and in particular, the provision of oxide layers of different depths on respective opposite sides of a relatively thin film silicon, as is the case in the micro-mirrors 10 formed in the intermediate layer 5 (second layer) causes undesirable stresses to be induced in the relatively thin layer of silicon."

Accordingly, in order to reduce such stresses, a part of a portion of the first etch stop layer adjacent the portion of the second layer where the component (micro-mirror) is to be formed is etched to thin the etch stop layer. In other words, the etching is carried out in order to reduce the depth or thickness of the first etch stop layer adjacent the micro-mirror. It is therefore respectfully submitted that claim 28 clearly and unambiguously claims this feature of the invention. It is respectfully submitted that the amendment to claim 28 proposed by the Examiner misses the entire concept of the invention. The etching is not achieved by thinning the first etch stop layer, rather, the thinning of the first etch stop layer is achieved by etching the first etch stop layer.

Since the word "thinning" in claim 28 is confusing the Examiner, Applicants have amended claim 28 to replace the word "thinning" with the phrase "for reducing the depth". It is respectfully submitted that this amendment makes it perfectly clear that the etching step is carried out for reducing the depth of the first etch stop layer adjacent the portion of the second layer where the component is to be formed.

Turning now to claim 29, it is respectfully submitted that the reason the first etch stop layer adjacent the component is thinned to a depth relative to the depth of the second etch stop layer for relieving stress in the portion of the second layer where the component is to be formed would be eminently clear to any person skilled in the art, and indeed, as discussed above, is clearly discussed in the specification from page 13, line 13 to page 14, line 10, and in particular, at page 13, line 23 to line 27, and thereafter to page 14, line 11.

In view of the amendment which has been made to claim 28, whereby the term "thinning" has been replaced by the term "reducing the depth of", a similar amendment

has been made to claim 29. It is respectfully submitted that claim 29 now clearly and unambiguously claims the invention.

For the sake of consistency, Applicants have made similar amendments to claims 9, 30, 31, 35, 36 and 37 where the terms "thinning" or "thinned" are used.

Turning now to claim 38, Applicants contend that the Examiner's proposed revision does not clarify the claim. Accordingly, in order to ensure that the invention is clearly and unambiguously claimed in claim 38, Applicants have amended the claim to make it clear that it is the cross-sectional area of the communicating bore adjacent the component which is to be at least half the area of the component in plan view, rather than the smallest cross-sectional area of the communicating bore. Accordingly, it is respectfully submitted that with claim 38 so amended, the invention is now clearly and unambiguously claimed in claim 38.

With respect to the objections to claims 12 and 34, Applicants contend that the claims are clear and concise as they stand. There is clear support in the specification for maintaining the claims in their broad form. For example, at page 10, lines 15 to 17 it is stated that:

"The first and second etch stop layers 8 and 9 are both oxide layers which in this embodiment of the invention are grown on their respective adjacent lower and intermediate layers 4 and 5, respectively."

Further on in the specification at page 11, line 30, Applicants refer to the fact that the first etch stop layer of oxide is thermally grown, and on page 12 at line 13 we refer to the fact that the second etch stop layer 9 of oxide material is thermally grown. There are also statements of invention in the specification which support both claims 12 and 34,

these appear at page 4, lines 9 and 10 and page 4, lines 21 and 22. Similar statements of invention appear at page 6, line 20 and page 7, lines 31 and 32.

In sum, there is no reason why claims 12 and 34 should be amended to be restricted to thermally grown layers.

In view of the foregoing comments, Applicants contend that all of the claims are now in full compliance with 35 USC §112. Accordingly, Applicants submit that all of the claims should now be in condition for allowance, and an early indication of same is respectfully requested.

A copy of the marked-up version of the amended claims is submitted herewith.

Respectfully submitted,



Matthew E. Connors
Registration No. 33,298
Samuels, Gauthier & Stevens
225 Franklin Street
Boston, Massachusetts 02110
Telephone: (617) 426-9180
Extension: 112



1. (Amended) A method for forming a semiconductor device comprising first, second and third layers, with a component being formed in the second layer, and first and second etch stop layers being located between the first and second layers, and the second and third layers, respectively, and at least the second etch stop layer being bonded to one of the second and third layers, the method comprising the steps of:

prior to bonding the second etch stop layer to the one of the second and third layers [to the second etch stop layer], patterning the second etch stop layer to define the component in the second layer for facilitating etching of the second layer through the third layer,

bonding the second etch stop layer to the one of the second and third layers [to the second etch stop layer], and

etching the second layer through the third layer and the second etch stop layer for forming the component in the second layer.

9. (Amended) A method as claimed in Claim 8 in which prior to etching the second layer for forming the component initially only a part of the portion of the first etch stop layer is etched through the communicating bore in the first layer for [thinning] reducing the depth of the first etch stop layer for minimising stresses induced in the portion of the second layer from which the component is to be formed.

28. (Amended) A method for forming a semiconductor device comprising at least a first layer and a second layer with a component formed in the second layer, a first etch stop layer being located between the first and second layers, and a second etch stop layer on the second layer such that the second layer is located between the first and second etch stop layers, the first etch stop layer being of depth greater than the second etch stop layer, the method comprising the steps of:

prior to forming the component in the second layer forming a communicating bore through the first layer to the first etch stop layer adjacent a portion of the second layer where the component is to be formed, and

etching a part of a portion of the first etch stop layer adjacent the portion of the second layer where the component is to be formed through the communicating bore for reducing the depth of [thinning] the first etch stop layer adjacent the portion of the second layer where the component is to be formed to an effective stress relieving depth for relieving stress in the portion of the second layer where the component is to be formed.

29. (Amended) A method as claimed in Claim 28 in which the portion of the first etch stop layer adjacent the component is [thinned] reduced to a depth relative to the depth of the second etch stop layer for relieving stress in the portion of the second layer where the component is to be formed.

30. (Amended) A method as claimed in Claim 28 in which the portion of the first etch stop layer adjacent the component is [thinned] reduced to a depth so that the difference in thicknesses of the respective first and second etch stop layers does not exceed 2 microns.

31. (Amended) A method as claimed in Claim 28 in which the portion of the first etch stop layer adjacent the component is [thinned] reduced to a depth so that the difference in thicknesses of the respective first and second etch stop layers does not exceed 1 micron.

35. (Amended) A method as claimed in Claim 28 in which the area in plan view of the portion of the first etch stop layer the depth of which is reduced [thinned] is less than the area in plan view of the component.

36. (Amended) A method as claimed in Claim 28 in which the area in plan view of the portion of the first etch stop layer the depth of which is reduced [thinned] is at least half the area in plan view of the component.

37. (Amended) A method as claimed in Claim 28 in which the area in plan view of the portion of the first etch stop layer the depth of which is reduced [thinned] is at least three-quarters the area in plan view of the component.

38. (Amended) A method as claimed in Claim 28 in which the cross-sectional area of the communicating bore through the first layer adjacent the component is at least half the area of the component in plan view.